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Specification No.
469-333B

PRELIMINARY SPECIFICATION - BRIEFING PRINT ENLARGER - (No. 469-333B)
(First Revision)

PREFACE

The following tentative specification is being released prior to completion of the Prototype Enlarger. It may be necessary to revise some items as more information about the Enlarger performance becomes available.

Declass Review by NGA.

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1. EQUIPMENT APPLICATION

The enlarger is designed for rapid, convenient production of large photographic prints for unaided visual observation, as in group briefing or for report illustrations, from high-quality aerial photographic negatives in roll form.

2. DESCRIPTION

2.1 The enlarger has a horizontal optical axis with a moveable print stock easel to provide a range of negative-to-print distance from 50 to 80 inches. The print stock easel, lens, and negative gate are rigidly coupled together by a massive steel structural member which is, in turn, isolated from environmental vibration by rubber-in shear mounts.

2.2 The easel surface is 41 inches square and provides vacuum holding for cut sheet print stock at any position on that surface.

2.3 A magnification range of 3X to 60X, with the range of negative-to-print distance described above, is achieved for black-and-white prints with a specially designed set of six lenses. The focal lengths of these lenses were chosen to provide a continuous range of available magnification, as shown in Table I, page 3. Five of the six lenses are also suitable for color printing, providing magnification from 3X to 39X for color prints. To provide the necessary focus accuracy, each lens is mounted in its own focusing assembly, including a negative gate glass.

2.4 The required focus setting for each of the six lenses for various negative-to-easel distances (steps of 0.2 inch through the 50 to 80 inch range) is displayed in a mechanism coupled to the easel drive to show only the focus setting and magnification for the particular lens and negative-to-print distance which exists. The lens focus is set manually to make the focus indication counter on the focusing assembly agree with the displayed value from the tabulation.

2.5 The illumination is produced by 300-watt tungsten projection lamps with condenser lenses. A separate condenser and lamp assembly is provided for each objective lens and the assemblies are designed for convenient interchange in the lamphouse.

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TABLE I

BPE Specifications for Nominal Magnification, EFL, and f-number and for Minimum Axial Resolution and Field Diameter

Nominal Magnification		Lens		Minimum Axial Resolution		Minimum Field Diameter	
M (Diameter)	OAC (Inches)	EFL (Inches)	f-Number	Negative (1/mm)	Print (1/mm)	Negative (Inches)	Print (Inches)
2.95	57.	10.75	f/17.8	80.	27.	3.7	10.9
3.77	65.				21.		13.9
5.24	80.				15.		19.4
4.75	50.	7.17	f/12	113.	23.	3.7	17.6
6.48	62.				17.		24.0
9.04	80.				12.		33.4
8.46	50.	4.85	f/7.8	200.	23.	3.7	31.3
11.0	62.				18.		40.6
14.7	80.				13.		54.4
14.5	50.	3.06	f/5	320.	22.	2.10	30.5
18.5	62.				17.		38.8
24.4	80.				13.		51.1
24.5	50.	1.90	f/4.2	400.	16.	1.24	30.4
30.8	62.				13.		38.2
40.3	80.				10.		50.0
38.5	50.	1.24	f/2.8	550.	14.	.79	30.4
48.2	62.				11.		38.1
62.7	80.				9.		49.5

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2.6 A three aperture filter wheel whose position is selected from the control console is provided in the lamphouse. The filters are readily interchangeable to provide for optimum exposure conditions for a variety of print materials.

2.7 Exposure control is accomplished from a control box on the side of the main enlarger frame. Exposures are started and ended by turning the projection lamp ON and OFF. The exposure time is controlled by a decade timer for times up to 111 seconds in 0.1 second steps. (Effective exposure is proportional to exposure time for exposure time greater than two seconds). Irradiance level in the projected image is controlled by adjusting the voltage applied to the lamp. Three variable autotransformers are connected such that a particular transformer supplies power to the lamp for each particular position of the filter wheel. Provision is made for extended time projection through any of the filter positions for image observation or photometer measurement of the projected image. Timed exposures may be made through any of the three filters as selected at the control box or through all three in sequence with the same time of exposure for each.

2.8 The roll-negative transport system winds the web horizontally between the two spindles mounted with their axes vertical. The transport system is moveable up and down by a motor drive to place the film in front of a viewer or to lower it into the negative gate with the ability to place any point on the width of the web at the optical axis. Negatives 70mm to 9.5-inches wide mounted in flanged film spools (MS26565, 12 Sep 62) up to 7.6 inches in diameter can be mounted on the transport.

2.9 In the negative gate, the film is clamped between glass plates under spring pressure to hold it in the correct focal plane. As the gate is partially closed, a small quantity of index matching fluid (tetrachloroethylene) may be injected on each side of the film which wets the film and glass surfaces over the gate area upon full closure of the gate.

2.10 Interlocks are provided to prevent moving the negative while it is clamped in the gate. A ventilation system is provided to remove the fumes of the immersion fluid to an outdoor exhaust. After the gate is opened, the transport system must be driven upward to move the wet film area past a liquid removal unit before it is possible to wind the film by motor drive into either spool.

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2.11 An easel spot photometer is provided to aid in predicting correct print exposures for black-and-white or color materials.

2.12 A coordinate measuring system is provided to aid in positioning in the printing gate images which are described to the operator by coordinates of position within a given numbered frame of the roll of negatives. The unit of coordinate measurement in the system is one millimeter.

3. PERFORMANCE

3.1 The nominal values of magnification (M), effective focal length (EFL), and relative aperture (f-number), are given in Table I for the six lenses. The magnification achieved for a given negative-to-print distance (OAC) may vary ±2% for various lenses of a production lot. The magnification value shown in the focus table may be in error by ±1% from the true value.

3.2 The Minimum Axial Resolution specification of Table I shall be applied to tests made in the following manner.

3.2.1 The test target material shall have at least 100:1 contrast, be in the USAF 1951 format and provide 80 to 800 lines/mm. The material shall have been exposed on Kodak Type 649GH film on the Microscope Resolution Target Camera at the contractor's facility. The test target polarity will be clear lines in a high density background.

3.2.2 Test prints on the BPE are to be exposed on Kodak Fine Grain Positive Film (or on equal product) with a Wratten 98 (W98) blue filter in the lamphouse filter position.

3.2.3 Resolution performance will be judged as the highest spatial frequency in the test target whose image is visually resolved in the print. The criteria for judgment of image resolution shall be those of Paragraph 3.6.2 of MIL-STD-150A.

3.2.4 An exposure series may be exposed to obtain the optimum resolving power. The lens focus setting shall be that predicted by the focus table.

3.3 The off-axis resolving power shall be measured at the same focus and exposure which provided the axial resolution data and to the same criteria. The same type of test target material shall be used, preferably on a common

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piece of film. The arithmetic average of radial and tangential resolving power for four radii of the field of view, separated by 90°, at a radial distance of 70% of the full field radius, shall be no less than 70% of the resolution measured on-axis.

3.4 The Minimum Field Diameter at the negative, as specified in Table I, is primarily controlled by the various aperture diameters in the condenser system. The field diameter at the print is determined by the field diameter at the negative and the magnification. The specified field diameter at the print shall be measured with the negative-to-print distance adjusted to produce the corresponding magnification given in the first column of Table 1.

3.5 The temperature of a photographic density sample having a uniform density of 1.0 shall not be high enough to damage the sample at the stable temperature level. A sample of Type 3404 film shall be flashed and machine processed to produce the required density. The film sample is to be inserted in the gate with immersion fluid and the enlarger operated for twenty minutes continuously with the lamp at 115 volts and no filter in the filter wheel. At the end of this test, the film sample must not show evidence of heat damage.

3.6 The enlarger (4.80-inch lens, on-axis) shall provide exposure in sixty seconds on Kodabromide F2 paper to produce 0.1 density above fog level through a density of 2.0 (ASA diffuse density) in a Kodak Photographic Step Tablet with the W98 filter and the lamp operating at its rated voltage for 25-hour life at 80 inches OAC.

3.7 The log illuminance in the projected image of an open gate shall not decrease more than 0.30 below that on the axis at a point 0.8 of the maximum field radius from the axis.

3.8 The digital output of the coordinate measuring system, in either X- or Y-coordinate, shall be within 1% of the actual sample movement in millimeters, or within one count, whichever is greater.

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3.9 The time-of-exposure as produced by the Lektra Labs Model TM-8 timer shall be within ±5% of the timer setting for settings between 3.0 and 110 seconds. The variation of time-of-exposure for a succession of five exposures shall not exceed a range of 4% of the mean time-of-exposure for the set.

3.10 It is of extreme importance that the negative transport assembly or the negative gate and exhaust shroud shall not damage the valuable negatives to be printed by the Enlarger. Those areas shall be free of sharp corners, sharp edges or burred surfaces which may scratch the film. A practical test to detect such items should be made by installing a piece of fresh, flashed and processed film. The film should be run in both directions across the viewer and through the gate area. The gate should be closed with fluid injection, and opened with the drying cycle, with the same film sample. The film should then be examined for possible damage in those handling operations.

4. ENVIRONMENT, SPACE AND SERVICE REQUIREMENT

The requirements of the Enlarger in these respects are given in the Installation Engineering Data, Drawing Number 1-023-B-513.

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